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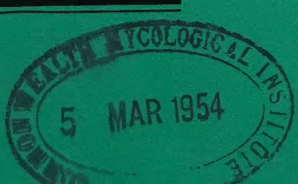

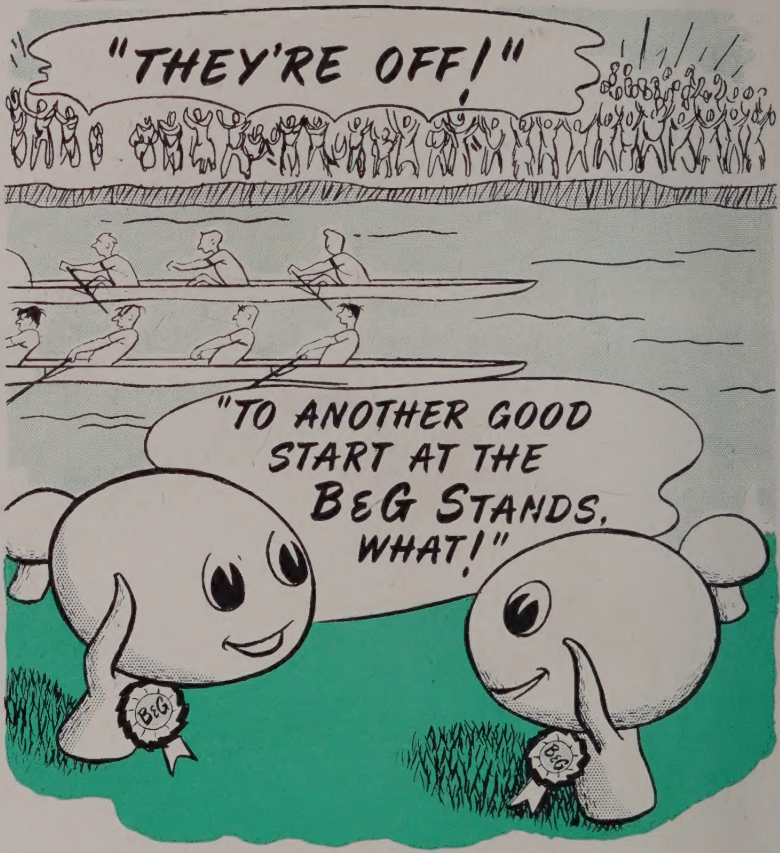

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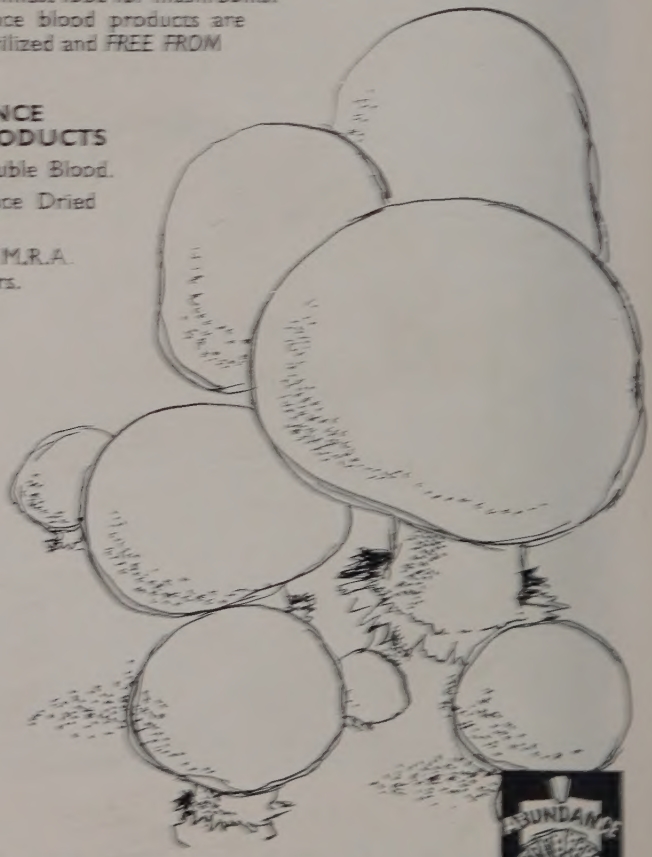

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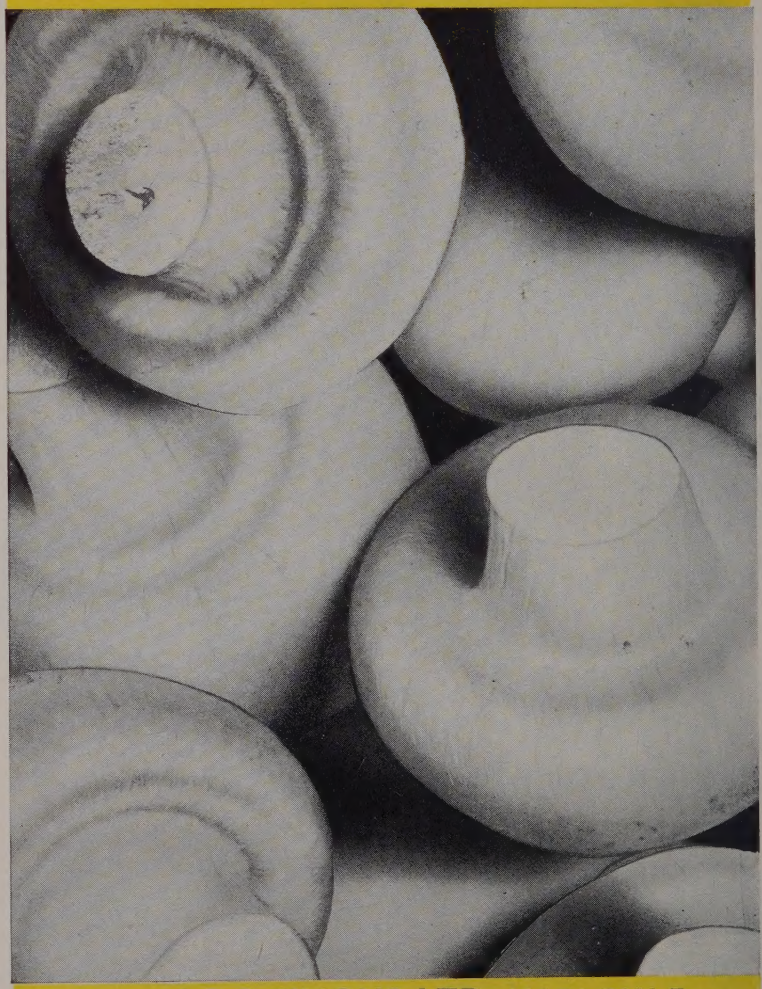

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The **MGA BULLETIN**

MARCH · 1954

NUMBER 51

EDITORIAL

PRICE TRENDS

The recent spell of cold weather discouraged mushroom growth even in the best insulated houses, and from many different parts of the country came the same groan: *My cropping is down 25 per cent.*

A Covent Garden salesman told me at the time that mushrooms were scarce, and I said: " It's a good thing prices are better, but I can't imagine why people want more mushrooms the moment the weather turns cold."

His reply was interesting, " But they don't," he said. "As a matter of fact, the demand has slackened, but not as much as the supply, and that is why prices are up."

Apart from publicity (which, despite the most energetic efforts of the MGA Executive and its Sub-Committee, is slow to get started), we can do little to affect the price of mushrooms, but I cannot help wondering what are the governing factors.

In 1950 I had a shock to find my own company's average after deducting commission had dropped to 3/8, which was 8½d. below the 1949 average. Then, in 1951, for reasons I cannot imagine, the average rose to 4/-. It fell a little to 3/10 in 1952, and last year slumped by 5d. to 3/5—the lowest average since 1940. (I am told we were lucky to get 3/5; some got less).

The prognostication of one grower who has been long in the business is that prices will even out around 3/3. Any guess is bold, but this strikes me as being far too optimistic. **Why shouldn't they go down to 2/6?**

At any rate, if it cost me 2/6 to produce a pound of mushrooms I would be concerned for my future. So should you be!

What are we going to do about it, in case?

Fred C. Atkins.

The Glasgow Evening Citizen of 9th December, 1953, carried a most interesting article on Matthew Pinkerton's latest venture, and this introduction to it is reproduced by permission of the Editor. A staff reporter wrote:

GROWING IN SCOTS CAVES

It all started with a swim

An industry is growing—mushrooms, in fact—in old limestone caves at Thorntonhall, near East Kilbride.

And this mouth-watering enterprise is developing so quickly that in about four years time it is likely to equal the present total output of Britain's mushroom growers.

It is just about a year since a frogman went for a swim in the caves. The frogman is 35-year-old Matthew Pinkerton, mushroom grower. He has a plant at Hogganfield.

He had seen mushrooms grown in caves in America, then discovered the workings at Thorntonhall, abandoned since about 1918.

The entrances to the workings were covered by earth. Only three small holes could be seen.

DEEP-SEA DIVER

During The War

Mr. Pinkerton, in a frogman's suit—he trained during the war as a deep-sea diver—was lowered on a rope into the black water-filled caves.

He swam through the workings, past great limestone pillars left by miners to support the roof.

His swim convinced him the caves were perfect for mushroom growing.

" If I had been asked to draw up plans for a mushroom plant they would have been exactly as the workings are laid out," he told me.

The MGA Bulletin's Board thought such a story justified a description from Mr. Pinkerton's own pen, but he passed on our request to **Robin Walker,** who sent us the following, which has been approved by Mr. Pinkerton:

The first cavern of seven acres is now in full production; a second, much larger, will be brought into use during the course of the present year. But the full potentialities of the developments can be best appreciated by a glance at the following data. There are four major caverns in the group, giving a total area of approximately 100 acres. These are all capable, as demonstrated in the first cavern, of taking intensive tray-production, to the extent of approximately 64,000 sq. ft.

to the acre. Over 100 acres this gives a potential production area of 6,400,000 sq. ft. With cropping in the region of $1\frac{1}{2}$ lb. per sq. ft., a potential output per rotation is 9,600,000 lb. When multiplied by five (crops *per annum*), this gives **an annual output of 48,000,000 lb. of mushrooms.**

The first cavern now in full use extends to seven acres and is typical of the other larger caverns. In this particular cavern there is a wide main road running straight across, while another road circles it. The area within this circular roadway is clear except for the rows of massive limestone pillars which support the roof. These pillars vary in girth, but a fair estimate might be 20 ft. across. The spaces between the outermost pillars have been walled up to make rooms for special purposes such as soil storage, soil preparation, etc. The roof is about 10 ft. high and is bone dry, as is the entire cavern; the floor is remarkably level and of solid limestone rock, making the area ideal for this type of work.

Although there is a sump near the entry to the cavern with appropriate pumping plant, the actual daily clearance of water is negligible and comes rather from the materials in use than from strata. Every part of the cavern which I explored was completely dry.

The working policy which has been followed here is roughly as follows : After clearance of the cavern, withdrawal of water and of rubble, arrangement of main roadways, etc., the sections to the left of the main boundary road intended for pasteurising chambers were bricked off and equipped with steaming gear. These chambers take some 10,000 trays each, giving a total capacity of 60,000 trays. Live steam is injected under thermostatic motorised control at 136/140° F. and the trays are transferred thereafter to the adjacent growing chambers.

Composting is done in special barns erected some distance from the mine entry, considerable use being made of artificials, distillers' waste and straw being main constituents. Soil is taken from the surface above the caverns so that the enterprise is fairly self-sufficient for raw materials.

One of the most satisfactory features of the caverns is the equable temperature which prevails. With perhaps 100/120 ft. of rock and soil insulating the actual chambers, the internal temperature is stable around 58° F. I personally checked the temperatures on this visit at 60°. This provides an ideal condition under which to work, the more so since even a hard frost cannot penetrate this far underground; add the fact that the unfluctuating, suitable temperature is natural and free, and its value can be the more appreciated.

The area in use is so large that there is no question of stuffiness or claustrophobia, and the workers with whom I discussed the point declared themselves completely satisfied with their working conditions.

Mechanical ventilation is used to exhaust and refresh the underground air, at the rate of six changes per hour, and preheating of incoming air is carried out to bring it up to cavern temperature.

In the actual working of the caverns the company has shown itself alive to the need for maximum mechanisation. Tractors are used extensively, the roads being wide and smooth to allow easy operation of even the larger types. Roller conveyors are used for all handling work and every job which can be done faster and more cheaply by machine is so dealt with.

To maintain this system at its peak efficiency the company has at its back a very modern and alive workshop. Here new ideas are worked out and prototypes built for the faster handling of all phases of mushroom production; a full system of stock components is operated so that replacements can be effected without loss of production.

Equally vital to the success of the new venture is the existence of a background of experience and skill in spawn cultivation, and a world-wide system of marketing.

It is intended to open up the remaining caverns gradually and so bring the whole area under cultivation; the economics of this development are obvious in that the existing organisation and plant can be partly shared over the four caverns so that all future developments can be made at a comparatively small cost.

It is also planned to create canning facilities on the site in due course to take over any surplus output which cannot be immediately cleared to the market. Here again, a background of experience is available in that some work has been done in this direction over the past years.

Credit for this major development of Scottish mushroom industry goes to Matthew Hamilton Pinkerton, whose work in this field is well-known; he is the chief director of Thornton Cavern Mushrooms Ltd., and the Secretary is Evelyn Mitchell.

That Phorid !

George Schwartz in the *Sunday Times* is always readable, and in the 13th December issue, speaking of the unseasonable weather before Christmas, he pointed out that it had brought on chrysanthemums early, and the price in consequence was 3s. a dozen at Covent Garden instead of the usual 1s. each. The cheapness of chrysanthemums spoiled the market for carnations. Premature narcissi from France made matters worse, and the mushroom crop, which might have acted as a stabiliser, was attacked by a new pest, the Megaselia fly. He concludes: " Keep (this fly) in mind. History may record it as the origin of the consummate depression that ended Western civilisation."

Master Schwartz always makes us laugh; but every now and then we wonder whether we ought to. Certainly, to us growers, *Megaselia plurispinosa* is no laughing matter. All we know about it (we think!) is how to spell it.

WHO'S WHO ?

Conny Riber Rasmussen, Director of mushroom research in Denmark, was born at Ravnholt Castle in 1924, and graduated from Birkerod State High School in 1941. He has had five years' practical horticultural training on nurseries and mushroom farms. He joined the Royal Danish Life Guards in 1943, and was taken prisoner by the Germans; he rejoined in 1945 and later entered Vilvorde Horticultural High School, graduating in 1947. In 1950 he gained his B.Sc. (Hort.) at the Royal Agricultural College. He has always been particularly interested in mushroom growing, for his father started growing them in 1935. In 1951, he studied experimental technique with Dr. P. J. Bels in Holland and with Dr. R. L. Edwards in England, and in 1952 he spent four months in the United States of America visiting mushroom growers and laboratories. In October, 1952, he was appointed Technical Director of the newly-started Danish Mushroom Research Station in Copenhagen.

Mr. T. Ainslie Robertson, Chairman of the Board of Management of the new National Glasshouse Crops Research Station being built at Toddington, Sussex, has kindly consented to be our **Guest of Honour at the next Annual Mushroom Lunch at Tunbridge Wells, Kent, on 7th October.** Research on Mushrooms is on the Toddington programme, and within a year the MRA work at Yaxley will be transferred there. At the present moment Mr. Robertson is Chairman of Plant Protection Ltd., but he is retiring from that office. He was largely responsible for organising Fernhurst Research Station, which has been described as a model of its kind. Among his Governors is Mr. W. H. Young, the mushroom grower who for some years was Chairman of the Worthing & West Sussex Growers, and the MGA looks to him to watch the interests of the Mushroom Industry.

THE CULTIVATED MUSHROOM

9—CYTOLOGY (*continued*)

By ANDRÉ SARAZIN

3. Lipoid Inclusions of the Cell Wall and of the Food Reserve

In the cytoplasm of the cells of the various parts of the Cultivated Mushroom (mycelium and carpophore) may be seen, as in all vegetative cells, minute refractile globules which are small lipoid globules stainable microchemically by Sudan Red and Sudan Black and capable of reducing osmic acid. They occur nearly always as free entities distributed here and there in the depth of the cytoplasm. In some cases, as for instance in the basidia subsequent to the formation of the spores, they are very numerous, so much so that they flow together to form pools. It seems as though there is here an actual disintegration of the lipoproteic complexes of the cytoplasm culminating in a fatty degeneration of the basidium, a phenomenon which Guilliermond called lipophanerosis. When the spores reach maturity they contain reserve substances in the form of highly refractile fatty globules which are stained by Sudan Black (Fig. 1.).

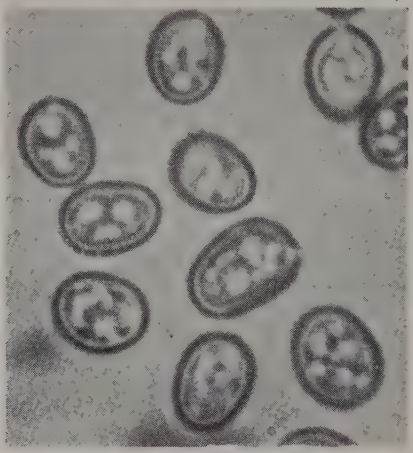


Fig. 1. Photomicrograph x 2,000. Basidiospores containing refractile fat globules.

Glycogen is to the Fungi what starch is to green plants. It is a condensation carbohydrate which serves as a food reserve substance. It is characterised microchemically by the reddish-brown colour which it acquires when treated with an aqueous solution of iodine. It appears first in the cytoplasm of young cells in the form of minute droplets which become united to form pools in older cells (Figs. 2 and 3). It is only when the cell is literally crammed with it that it overflows into the vacuole where it occurs in colloidal solution in which the granules manifest Brownian movement. Glycogen is rather abundant in the carpophore of *Agaricus campestris* since it reaches a concentration of 0·59% of the fresh weight or 4·95% of the dry weight (McConnel and Esselen 1947). As regards its distribution in the carpophore, my observations show that it is most abundant in the central part of the stalk and in the zone extending from this part as far as, and including, the gills. It is absent from the cells of the epidermal layers of the cap.

In the mycelium, it is absent from the growing points of the hyphae, while in older portions its abundance is proportionate to the amount of sugar in the medium. (*c.f.* Photomicrograph No. 4 in *MGA Bulletin* for May, 1952.)

It should be noted that, in the cytoplasm of the carpophore cells, protein crystalloids are frequently met with which are microchemically characterised by reactions specific for proteins, as for instance the Biuret and Millon tests.

Some hyphae occasionally contain them in large numbers, and sometimes they reach a considerable size. (Fig. 4.)

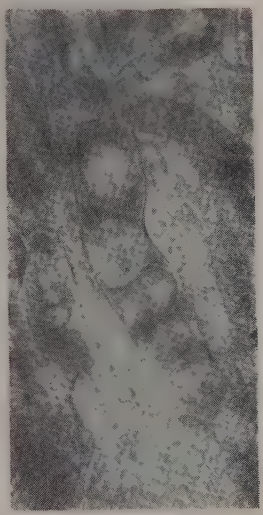


Fig. 2. Photomicrograph x 580. Giant hypha stained with iodine to show glycogen in pools around the vacuoles.

Fig. 3. Photomicrograph x 580. Plectenchyma cell from central portion of stalk. Stained with iodine to show glycogen in pools around vacuoles.

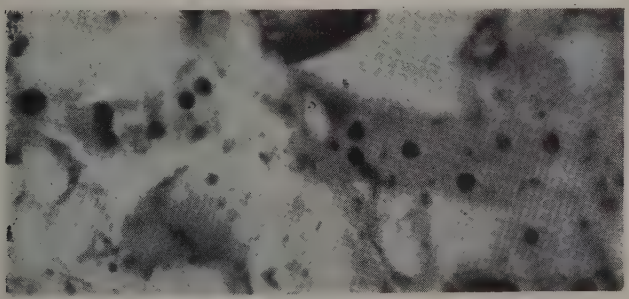


Fig. 4. Photomicrograph x 1,500. Hyphae showing numerous protein crystalloids. (Preparation fixed and stained.).

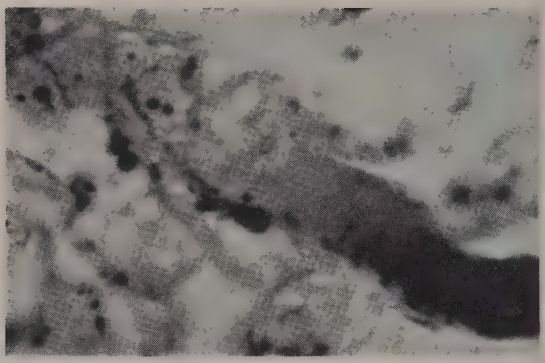


Fig. 5. Photomicrograph x 1.500. Hypha with accumulated fats. (Fixed and stained preparation.)

In the carpophore of the Cultivated Mushroom there are certain hyphae which are so orientated in their growth that they lie across the vertical axis of the bundle of parallel hyphae which make up the plectenchyma. Hein (1935) described the morphology of these hyphae which he regarded as constituting a conducting system for the transport of substances throughout the carpophore. These hyphae are septate. Their cytology and evolution in the depth of the carpophore has been studied by me. While they are not as characteristic as are the lacticiferous hyphae described in the Lactarius or Russula groups they nevertheless exhibit microchemical features which are akin to them. In the growing zone their cells contain nuclei, a chondriome and vacuoles, and differ only from neighbouring cells in their capacity for accumulating large quantities of glycogen, protein crystalloids and oil in the form of large osmic acid-reducing pools. (Fig. 5).

Towards the base of the stalk, these hyphae seem to be devoid of any living substance which might be uniformly stained by Neutral Red (Fig. 6). Their content is stained a bright red by Fuchsin and blackish green by Sudan Black and is therefore very rich in fats.

During the maturation of the basidiospores the progressive transformation of the glycogen into fatty globules may be observed. When the basidiospores germinate the converse takes place: the fatty globules are progressively replaced by glycogen in the germ-tube.

This phenomenon is brought sharply into focus if germination is brought about in pure distilled water. Under these conditions the possibility of a synthesis of glycogen within the germ-tube from sugars contained in normal germination media can be ruled out.

Each cell is limited in all three dimensions by a cell wall. It is conceded that in the higher fungi, which include the Cultivated Mushroom, the chemical composition of the wall includes a chitinous base (Frerejacques, 1946) the molecule of which is built up by the linkage of a large number of molecules of acetylglucosamine. But the concentration of chitin is estimated at about 7% of the dry matter in the

Cultivated Mushroom and at 10 to 40% of the dry weight of the cell-walls. Other chemical substances such as hemicelluloses and callose must therefore be present with chitin.

It is this callose which is responsible for the blue colour in cell-walls stained by Cotton Blue. This point requires further investigation.

In the mycelium the transverse wall is laid down as a ring across the hypha. In older hyphae a granular siderophilous (having an affinity for iron) pad is formed against each side of the transverse wall. The pads become more prominent as the importance of the hyphae increases and in the cells of the mycelial strands which terminate at the base of the stalk they form hemispherical disymmetrical hat-like pads covering the transverse wall on either side. This characteristic appearance is found in the thickenings of all the cells of the carpophore (Fig. 7). They attain a relatively large size in the gills and in some hyphae of the plectenchyma which Hein (1930) identified as very active transport channels in the carpophore. In a given row of superimposed cells the more important of these hemispherical but disymmetrical pads is always placed in the same relative position. Hein observed a minute communicating channel between them through the transverse wall. He did not however determine the microchemical composition of these thickenings, observing only that they stained red with safranin. My own observations reveal that they are strongly siderophilic, reduce osmic acid, become stained a brownish black in Sudan Black, give a positive reaction with the Smith-Deitrich technique and the proteid reaction of Turchini: facts which enable one to interpret them as proteids associated with phospholipids.

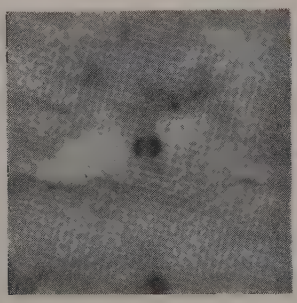
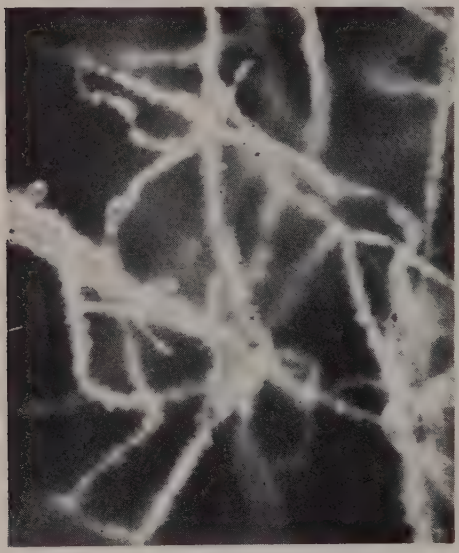


Fig. 6. Photomicrograph x 580. Hypha uniformly stained with Neutral Red.

Fig. 7. Photomicrograph x 1,800. Synapsis consisting of two hemispherical pads situated on either side of transverse wall. (Fixed and stained preparation.)

Fig. 8. Photomicrograph by reflected light x 400. Sheath of needle-like crystals surrounding spawn hyphae.



Attention has already been drawn to the sheath of fine needle-like crystals on the hyphae of spawn mycelium (Fig. 8) but it appears to be more in the nature of a crystalline deposit rather than an actual incrustation of the cell-wall.

Included in the above outline of the evolution of some cytoplasmic constituents of the Cultivated Mushroom are only such constituents as are susceptible of being demonstrated directly or else by micro-chemical staining reactions. Doubtless there are many others but their chemical instability or paucity in characteristic reactions does not permit of their being identified *in situ*, and accordingly they evade microscope investigation. They have been discovered by chemists in ground up carpophores from which they have been extracted and purified and then identified by fine analysis. The information obtained in this manner will be included in the account of the nutritive value of the cultivated mushroom which is to follow.

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John E. W. McCONNELL and W. B. ESSELEN, Jnr., 1947. Carbohydrates in Cultivated Mushrooms (*Agaricus campestris*). Food Research vol. 12. 2. March—April.

Marcel FREREJACQUES, 1946. Course in Practical Mycology. Revue de Mycologie. Fasc. 20.

ATTENDANTS ON TRAILERS

As from 1st January this year, the Minister of Transport has agreed that " where a land implement is drawn by a land locomotive or land tractor " an attendant (in addition to the driver) is now no longer necessary.

TRAY CROPPING SCHEDULES

HOW TO PREPARE THEM

By **Dr. R. L. EDWARDS**

In order to take full advantage of the merits—if any— of the Tray System, it is essential to have a cropping schedule which is efficient and workable, and to keep to it.

The preparation of such a schedule seems to cause some difficulty, though in many cases the worst job is keeping to it; if tackled in the right way the preparation of a schedule is not difficult, and if any practical difficulties likely to occur are provided for at this stage, keeping to the schedule should not be too difficult either.

It must first be decided how many Heat Rooms and how many Cropping Houses are to be used. Usually one Heat Room serves three Cropping Houses, but this can be varied, and for example three Heat Rooms could serve eight Cropping Houses, in which case a complete cycle would involve filling each Heat Room eight times, total 24 crops, giving three fillings for each Cropping House. On a 10 week cycle for each Cropping House this would be done on 30 weeks, and each Heat Room would be occupied for $30/8 = 3\frac{3}{4}$ weeks. In practice it is advisable to allow one or more days for each Heat Room and Cropping House to be idle, so that a minor accident will not upset the whole subsequent programme.

Given the number of Heat Rooms and Cropping Houses, it must be decided how many crops a year are to be grown in each Cropping House.

Then Crops $\times$ Houses = Total Crops a year.

Total Crops $\div$ Heat Rooms = Crops a year per Heat Room.

The Heat Rooms are the key to the schedule; 52 $\div$ (Crops a year per Heat Room) = weeks in Heat Room.

For example: 6 Houses cropped 4 times = 24 crops a year
24 crops from 2 Heat Rooms = 12 crops a year per Heat Room $52 \div 12 = 4\frac{1}{3}$ weeks in Heat Room.

Each Heat Room must be filled every $4\frac{1}{3}$ weeks, = 30 days, and one Heat Room will be filled every 15 days.

It is not possible to work exactly to an interval involving a fraction of a day, and Saturdays and Sundays also upset the rhythm, but if the long term interval for one Heat Room is fixed first, the others can be fitted in between afterwards.

Now a chart is needed, with a horizontal time scale at least long enough to cover the time from stacking to the end of a crop, preferably longer, with a square for each day, and a separate row on the chart for each Cropping House. It is easiest to dispense with dates at first, and

call them Week 1, Week 2, etc. In the example already used, Heat Room A is to fill House 1 first, and this is shown by a P (peak-heat) on Monday, week 1; Heat Room B will supply House 2. The next crop in Heat Room A for House 3 will be peak-heated 30 days after Monday, week 1, i.e. on Wednesday, week 5. Mark this in on House 3 row on the chart, and also the next crop in Heat Room A, intended for House 5, peak-heated on Friday, week 9. Then we come back to House 1, which receives the next crop from Heat Room A; this will be pasteurised on Monday, week 14, 31 days later this time to avoid Sunday, and so on.

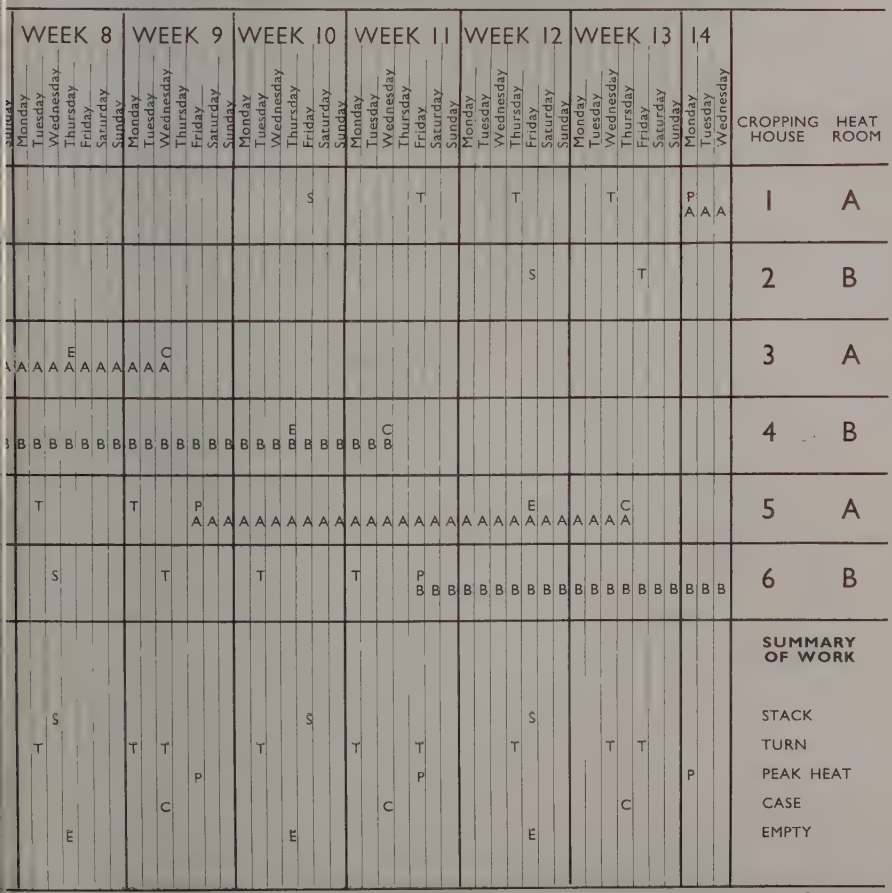
Next do the same thing for Heat Room B, starting with a peak-heat on Tuesday, week 3, in the row for House 2, and following on at 30 day intervals in Houses 4 and 6. Then we are back to Heat Room A for House 3, peak-heat Wednesday, week 5.

CROPPING HOUSE	HEAT ROOM	WEEK 1	WEEK 2	WEEK 3	WEEK 4	WEEK 5	WEEK 6	WEEK
		Monday Tuesday Wednesday Thursday Friday Saturday Sunday	Monday Tuesday Wednesday Thursday Friday Saturday Sunday	Monday Tuesday Wednesday Thursday Friday Saturday Sunday	Monday Tuesday Wednesday Thursday Friday Saturday Sunday	Monday Tuesday Wednesday Thursday Friday Saturday Sunday	Monday Tuesday Wednesday Thursday Friday Saturday Sunday	Monday Tuesday Wednesday Thursday
1	A	P A A A A A A A	A A A A A A A	A A A A A A A	A A A E A A A	C A		
2	B	T	T	P B B B B B B	B B B B B B B	B B B B B B B	B B B E B B B	B C B
3	A		S	T T	T	P A A A A A	A A A A A A A	A A A A
4	B				S	T	T T	P B
5	A						S	T
6	B	B B B B B B B	E B B B B C B					
SUMMARY OF WORK								
STACK			S		S		S	
TURN		T	T	T T	T	T	T T	T
PEAK HEAT		P		P		P		P
CASE			C			C		C
EMPTY			E		E		E	

Complete the series so that all the days for peak-heating each Heat Room are marked on the chart.

Then each Heat Room must be emptied a day or more before it is to be filled again. If you can be sure that there will be no delay, this can be the day before it is due to be refilled and peak-heated, but enough time must be allowed to cover emptying and cleaning with certainty. Mark this on the chart for each crop, e.g. for Heat Room A, House 1, on Monday week 5, with a C (transfer to Cropping House). The Cropping houses must be emptied before this; again the interval depends on the possible delay. If outside transport is to be used several days should be allowed. Mark this E (empty) on each House just before each C.

Then put in days for stacking and turning compost leading up to each P, the intervals being chosen to suit your normal composting



process; in each case stacking will be shown as S, anything from 7 to 30 or more days before P, with turns at intervals between.

Your schedule is then complete; fix a date for Monday, week 1, and enter corresponding dates for the duration of the chart and there is your operational time-table.

It is worth while to mark the periods when the Heat Rooms are full, with a different coloured line for each Heat Room, and also to check up on any overlapping of stacks of compost, to make sure that you are not arranging to make three stacks in a shed built for two!

It is also helpful to total up at the bottom of the chart the operations to be carried out each day or week; if too many fall on one day, something can be moved to the previous or the following day, and adjustments of this kind are better made beforehand than on the day when you find you are due to empty a house, fill trays and turn a stack, all with the same man.

In making adjustments, stacking and turning should be altered as little as possible because they may have most effect on the compost. Transfer to cropping houses, and emptying, if sufficient margin of time has been allowed, can be altered by a day or two either way with no ill effects.

The chart can be useful in testing the possibility of carrying out an intended schedule in several ways.

It shows what each week's work will be. It shows whether too little or too much time is being allowed in the Heat Rooms or Cropping Houses, and if so how adjustments can be made.

If times in both places can be reduced in the same proportion, more crops a year can be grown in the same buildings. If cropping time is to be reduced, but not Heat Room time, more Heat Rooms will be needed; and vice versa.

The chart shown here is self-repeating, i.e. all operations and times in week 1 are the same again in week 14, and in week 27; week 15 is the same as week 2, and so on.

Schedules do not always work out as simply as this one, but they can always be made to repeat after a suitable interval.

MAC'S MUSHROOM FAMILY

3. Rev. Titus Thallus

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At the end of the current financial year, i.e., 31st August, 1954, honorary members who pay a two guinea subscription will be classified as Associate Members. The following, who remain as Honorary Members, were omitted from the List of Members published in Bulletin 48:

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WATERMAN, G., Worthing & West Sussex Growers, 140 South Street, Tarring, Sussex.
WILLAM, Dr. A., CFREC, Institut Agronomique de l'Etat, Gembloux Belgium.

THE CULTIVATED TASTE

John Richardson, of Wray Farm, Reigate, wrote to *Country Life* the following letter published on 10th December, 1953: Mrs. Leigh's letter (19th November) reminds me of a friend, now dead, who used to cultivate mushrooms in a shed and also owned meadows in which field mushrooms grew. A friend of his once categorically said that the field variety was very much better than the cultivated. So my friend invited him to dinner, offered him mushrooms from two dishes and invited his verdict. This, after several tastings, was in favour of the cultivated specimens.

FIRST STEPS IN GROWING

by McGregor Bulloch

3—CHOOSING A METHOD OF GROWING

It is only a few years ago that the Tray System of mushroom growing was taken up by a few pioneers in this country, and recently bitter arguments have been taking place as to whether it is a superior form of growing to the older Shelf System. Under ideal conditions on both sides, it is not yet possible to say which is the better.

Tray-growing lends itself readily to full mechanization but, as a rule, only when the farm is designed for trays. Generally speaking, it is a great mistake to convert an efficient shelf-bed farm to trays. Apart from the somewhat different technique involved, it is rare indeed for the layout of an established farm to be such as to permit of a conversion to smoothly-flowing conveyor lines, which are necessary for reducing handling costs on a tray farm.

Conversion to trays should be considered essential where the growing sheds are in such a poor state that nothing but minor repairs can be carried out, *e.g.*, where the insulation is very inefficient, and sufficient capital is not available for improving it. Again, if the bed structures are in a bad state, it would be cheaper to purchase second-hand fish-trays than to buy timber for new shelves. It will cost about 6d. per sq. ft. of bed area to install trays, which when properly handled should give a minimum of eight to ten crops before requiring replacement.

In the above cases, such capital as may be available would be expended on one or more peak-heating rooms, where the trays are subjected to a curing process before being moved to the growing sheds. Poor insulation in the latter, although to be deprecated, does not matter so much, since the trays will have been subjected to the high temperatures of the sweating-out process, and provided that the growing sheds are disinfected thoroughly, efficient production is possible.

There have been a number of articles in the *MGA Bulletin* dealing in detail with the comparative costs and efficiency of the two methods, and these should be consulted if there is any indecision at the outset. Any such discussion here would merely be repetitive, and it is intended rather that this article should convey to the novice what is the feeling of growing by either method. For those who would like to make their own calculations, the following figures may help. The average shelf-bed is about 8″ deep when filled with compost (varying from 6″ to 10″) while the normal fish-trays which are approximately 18″ wide by 30″ long by 6″ deep, hold about 5″ of compost, each tray having 3·64 sq. ft. of surface area. Growers on shelves normally crop from 2 to $2\frac{1}{2}$ times per annum in each growing shed, with 3 crops as an easily obtainable

maximum. The latter gives from 9 to 11 weeks cropping period depending on the quickness of coming into crop and the time of year. Tray-growers average perhaps 4½ to 5 crops per annum, with 6 as a maximum. 4, 5, and 6 tray-crops per annum give respectively 10, 8 and 6 weeks cropping, provided that the trays are left in the peak-heating room after the spawning operation, so that the mycelium is running well through the compost before they are cased and transferred to the growing sheds.

The differences in technique will be examined separately in a future article, but before the novice makes up his mind, here are a few aspects of each system as they will strike him later in his growing career.

Let us imagine a farm with 20 houses, each holding 1,000 sq. ft. of shelf-beds. In all but one or two of these houses there will be something to see at any given moment, and a good grower should inspect each house every day without fail. Although the day-to-day change in a house is small, the daily inspection is essential. With shelf-beds, it is a matter of a minute or less to size up not only the potential pick for the day, but also the approximate state of health of the whole house where a flush has reached maturity. Unproductive or disease-affected patches can be spotted at once.

The same houses filled with trays would be nothing like so easy to inspect. Standing at the entrance, one can see only a small fraction of the total number of trays, and it is necessary not only to walk up and down each gangway, but to bob up and down at every yard. Roughly speaking, if there are 500 trays in the house, one must be prepared to place one's eyes in 500 separate positions in order to inspect the house thoroughly, especially when disease-checking. This is an unfortunate drawback to tray-growing, but nothing can be done about it.

There is a compensation, however, and it is an important one. By virtue of the fact that the growing area is divided into hundreds of small sections, one gains in protection against insidious fungi such as " Truffle " which, starting at a point in the compost, travels through the beds of a shelf-bed house, and may affect a large area before being located, when nothing can be done to save the infected portion of bed. If " Truffle " appears in a tray, it is confined to the tray, which can be emptied separately and safely, thus helping to control possible carry-over to the next crop.

Watering of shelf-beds is carried out more easily and quickly than with trays, but new methods have helped to improve the latter operation. A vertical, wheel-mounted lance, fitted with several horizontally-projecting jets, can speed up the work, but needs intelligent handling.

Shelf-beds are easier to pick, for one or two reasons. There are occasions when one or two beds in a house have either no pickable mushrooms on them or such mushrooms are grouped, say, at one end, and are easy to see on entering the house. With trays, until one develops a sort of sixth sense, one is compelled to peer briefly into each tray.

If it helps the beginner, who must by now be considering nervously the pros and cons, I would add that it won't really matter which system he chooses. If he makes up his mind to master the art, he can make a success of either. I still don't know my own preference.

THE FRED. ATKINS ALPHABET—C

Cable Heating. The laying of electric cables in ground beds may enable you to get a peak heat—and so remove the greatest objection to such beds. But they seem to be as unsatisfactory as a means of heating beds during the spawn run as they are theoretically admirable. Devastating attacks of Truffle have been attributed to localized overheating by cable, aggravated by heavy spawn runs. Yet it seems obviously wasteful to heat the air to heat the bed and then to cool the air to cause the bed to fruit.

Canning. If you know in January what prices will be in June and July, and if you can get a contract at a higher price for those months from canning companies, why not sign? The answer is simple: Study the international market. England is a small country, and we can supply all the *fresh* mushrooms it needs. If we cultivate can-consciousness here, we shall open our market to certain overseas growers who—for reasons we seem determined to ignore—can grow more cheaply than seems within our power. (Don't complain about unfair competition from sweated labour: our national livelihood is dependent on exports to the United States, where wages are much higher than ours. You can't sell your mushrooms *and* eat them). The 10%—20% Tariff is on raw mushrooms only, by the way.

Carbon Dioxide. Much carbon dioxide is given off during peak heating, yet few growers think it worthwhile to ventilate during this period. Carbon dioxide is said to stimulate spawn growth, but during cropping a concentration as low as 2 per cent. (perhaps even 1 per cent.) will cause mushrooms to be stalky and have small caps, and a 5 per cent. concentration is said to stop production altogether.

Casing Soil. Priority Number One in Yaxley's research programme to-day. The scientific recognition of the value of peat as a useful component part of casing material is a by-product of lengthy investigation into the old but immensely important fundamental problem: What causes the spawn to fruit? Certain obvious functions are performed by the casing, but no one knows why some soils—soils which by every known test are capable of performing those functions—produce so poorly.

Cat's Ear. This tiny, delicate, white fungus, seen occasionally on our beds, really is a joy to behold—provided it doesn't make a nuisance of itself: and I've not heard of it doing so for many years now. Exquisite *Clitopilus cretatus!*

Cecid Larvae. The little Cecid Fly is rarely seen—and usually turns out to be a young Phorid when it gets under the microscope. The larvae, however, while only occasionally attacking a whole house, can be 100% destructive of any flush they attack. The first sign is a tell-tale streakiness of the stalk caused by these revolting grubs worming their way up to the delectable gills. Control of the larvae has so far baffled the entomologists and pesticide people.

Chaetomium olivaceum. The Olive Green Mould which suggests the compost has gone through a final fermentation at 145° F. plus. The first sign is the appearance of a fine greyish mycelium in the compost a week or two after spawning. Later on there is a peculiar musty odour as of abject poverty—which might well be the result of over-zealous pasteurization!

Chogging. Sussex slang for "trashing," which is Anglo-American jargon for "the removal of dead tissue, dead pinheads, roots, butts and so forth"—as my friend Al Kligman so comprehensively puts it. A tiresome task, and one often neglected by those who refuse to accept as fact that cleanliness is essential in the successful intensive culture of mushrooms.

Compost. Make another compost closely resembling one which has just done 3 lb. to the square foot, and you will have no idea what it will produce. That is one of the most infuriating problems of mushroom growing. If I had to judge between a number of efficient growers for the title Mister Mushroom, and if their average over, say, 100 consecutive crops were the same, I would choose him whose production was least erratic. Such a contest is not likely to arise, for it would be grossly unfair to assume that the farms of each entrant were identical in their cropping potential.

Composting. The most complex aspect of growing to-day, and the most fully documented. Few commercial growers in the world know why they do what they do do. They should read *Mushroom Science 2*.

Copper Sulphate. One of the most important recent developments in disease control may be the addition of 1 lb. copper sulphate per ton of compost, just prior to filling, to reduce the incidence of Truffle and Verdigris. I say "may be" because this MRA discovery has yet to be endorsed conclusively in commercial practice. It has had notable successes, but there have been failures; and Dr. Edwards is now warning intending users that in one isolated instance the use of live steam in conjunction with copper sulphate has resulted in a reduced crop—though whether the copper sulphate was to blame could not be verified. Certainly it must be applied as evenly as possible to avoid concentrations, and the MRA recommendation is to dissolve it in water and spray it on the compost at the last turn.

Creosote. One of the best ways to preserve staging in mushroom houses is to paint it with creosote "cut" by one-third petrol. Post-war changes in refining processes, and or the post-war use of sappy timber, have suggested creosote is a deadly enemy and the cause of that curious abnormality, Rose Comb Disease. It is still an excellent wood preservative, of course, but nowadays growers must use it with discretion.

Cyanide Gas. Powdered calcium cyanide is still used (I expect) to kill pests at peak heat. We are warned to hang conspicuous signs over the doors: "Poison Gas—Stay Out": for hydrogen cyanide will kill even a mushroom grower in a few minutes. Probably the easiest way to reduce a staggering Wages Bill.

PUFFS FOR PARTIES

Bacon and Mushroom Puffs

4 oz. chopped raw mushrooms
Few cooked button mushrooms for garnish
1 or 2 rashers of bacon, grilled and minced
1 dessertspoonful French mustard (or less of dry mustard moistened with vinegar or lemon juice)
1 gill white sauce
Pinch cayenne and salt to taste
1 teaspoonful chopped chives or parsley

Mix chopped mushrooms into white sauce when being cooked. Cook for several minutes, then add bacon, mustard and seasonings. When cool, sprinkle in chopped herbs. Use as filling for pastry puffs, adding "cap" of mushroom to each.

Salad Puffs

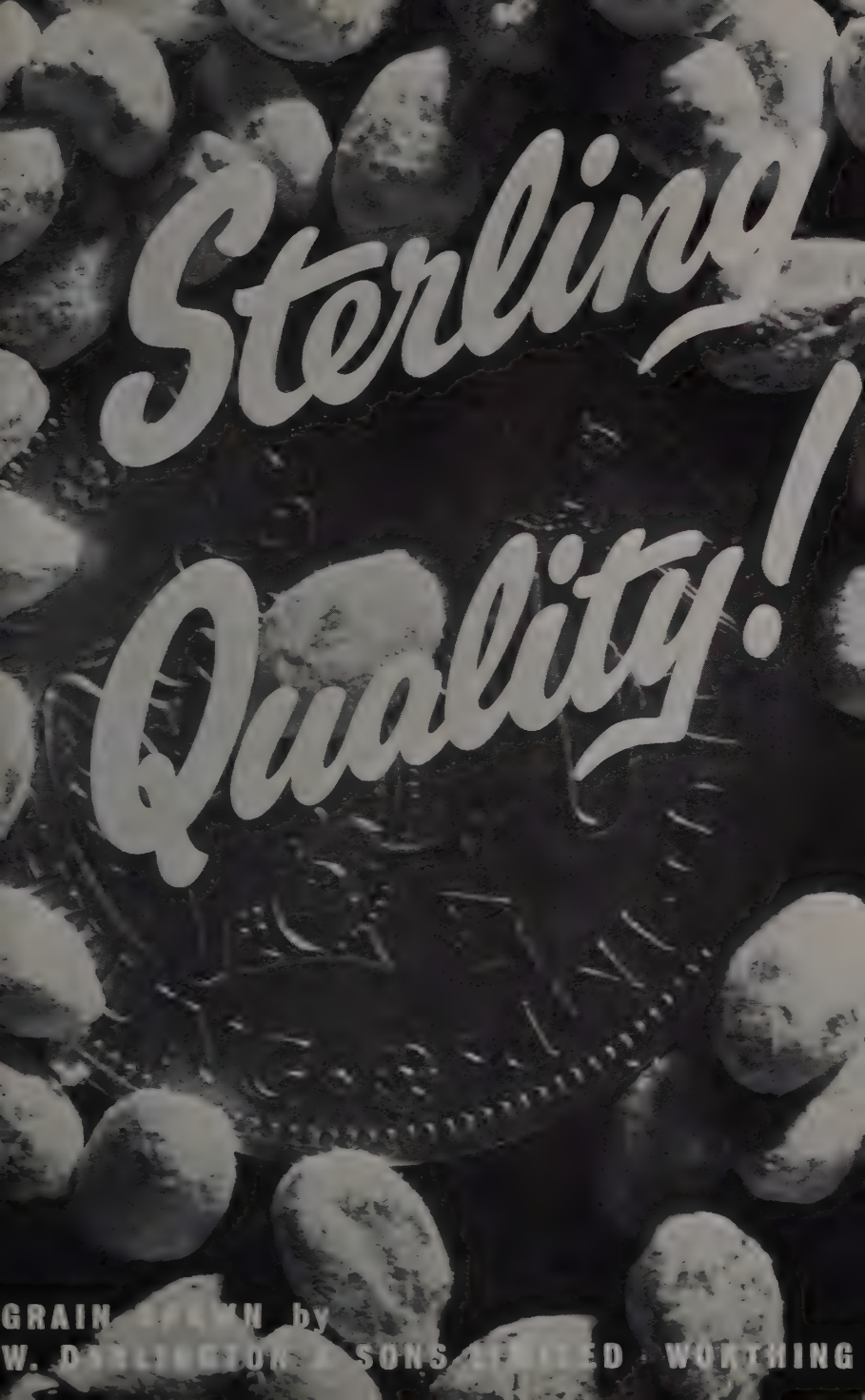
3 or 4 thin slices of ham, minced
1 good teaspoonful mustard (moistened with vinegar or lemon juice)
Piece of cucumber (diced small, sprinkled with salt, left awhile, then drained)
Few radishes
1 or 2 tablespoonfuls mayonnaise

Line cases with tiny crisp lettuce leaves. Mix filling ingredients, adding, if liked, some grated radishes and a few chopped gherkins. Heap mixture into cases and garnish each with tulip-cut radish.

Beef and Walnut Puffs

1 teacupful minced cooked beef (or corned beef)
2 or 3 pickled walnuts, chopped
1 gill white sauce (well flavoured with mustard and seasoned to taste)
Watercress for garnish

Mix filling ingredients and fill pastry cases. Garnish with sprigs of watercress.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ALFRED MOLINAS *tells of*

SPAIN'S MUSHROOM INDUSTRY

Spain, because of its geographical position, has a normally hot climate except in the central plateau, where winters are very cold and summers awfully warm. Consequently, mushrooms are grown underground in caves, in ridge beds. The Tray System and mushroom houses are unknown, because of the huge refrigerating problems which would occur during the four or five months when outdoor temperatures are around 105° F.

Mushrooms have been grown in Spain since the latter end of the last century, but the first reliable trial was not carried out until 1915, in a cave in Monjuich Mountain, in Barcelona. Since then, and until 1950, several plants were started, in Tarrasa, Segovia, Guadalajara and elsewhere, but due to the unsuitable sites, to the growers' technical ignorance, and to difficulties such as the importation of French spawns, most of them were unsuccessful.

Four years ago there was a revival of interest in mushrooms in Spain, and many growers looked around for places suitable for growing. It was not easy, for there are no locations resembling the French caves except in Majorca. Nevertheless, a number of farms were started; some were doomed to failure from the outset, but others possessed the required facilities and developed rapidly. Within a three-year-period, the annual output of mushrooms had been increased a hundredfold, and fresh mushrooms have appeared in many new markets.

The most important growing area is Campos, in the centre of the island of Majorca. The caves there closely resemble those in Paris. They have an area of about 400,000 square feet, and the present 16 growing " rooms " are being added to yearly.

A manure heap just stacked—afterwards it is divided into two stacks lengthways.

Horse manure is used, being both abundant and cheap in Spain. It is composted for about 18 days, a turn being given every six days. During composting it frequently reaches 180° F. Nothing is usually added unless the manure is old, when one to two per cent. of ammonium sulphate is added. Gypsum is added when the manure is too wet. Composting takes place in the caves, which helps to warm the air to 72° F.

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PENZANCE	SPALDING	SWANWICK

Ridge beds are made by hand 14 inches high on a 16-inch base. A moisture content of 60% is aimed at. Fresh spawn produced by the Micelio Hispania laboratories in Barcelona is used. Only small, white closed buttons are wanted; cream and brown varieties do not sell, and "opens" are regarded as rubbish.

Spawning takes place as soon as the bed temperature falls below 100° F. The Relative Humidity of the air is kept between 75 and 80% at 72° F.

Fifteen to 18 days after spawning, the beds are cased to a depth of nearly an inch with a lime soil (in the Mediterranean zone) or a clay soil (in central Spain). Cropping starts 15 to 20 days later, the air temperature now standing at 60° F. Yields vary from 2 to 4½ lb. per ft. run of ridge bed in 17 weeks.

The major difference between Spanish and French casing lies in the material. We use many different types, ranging from limestone to slate, but it is not yet possible to reach definite conclusions as to which are the most suitable under our conditions.

Diseases and pests are serious problems. Bacterial disease of various kinds is frequent, and is treated by spraying the beds with a 2% solution of chloride of lime. The most common disease is *Verticillium*, which we counter with alternate sprays of chloride of lime and hydroxyquinoline sulphate; but if the infection is heavy we remove the soil altogether and re-case, and if the disease reappears we water with a 1 : 600 solution of ethyl-parahydroxy-benzoate. *Mycogone* is not often seen; when it is, it is generally in association with *Verticillium* and the same control measures are adopted. *Dactylium* so far has appeared on only two farms. We do not distinguish between *Fusarium* and Mummy Disease, and it is causing much trouble at the moment; all we can do is to reduce the temperature and isolate the affected area. Brown and White Plaster Moulds appear in most crops but apparently cause little damage; if the casing soil is seriously infected the patch is replaced with fresh soil moistened with hydroxyquinoline sulphate.

Only one case of eelworm has been recorded, and it did little damage. Sciarids, phorids, springtails and mites are common but are successfully controlled by a lindane, DDT and pyrethrum mixture. After two years' use there is no evidence of resistance building up.

WHAT NEXT?

Do you fancy a mushroom that is poison-proof? It is being manufactured under U.S. patent No. 2,652,008 granted to Mr. James H. Zachary.

The inventor extracts gluten from wheat kernels and adds small amounts of yeast, flour, salt, onion and mushroom flavouring.

This mixture is forced into mushroom moulds of varying sizes and the resulting products are said to resemble real mushrooms in texture and taste. *Daily Herald*, 16.10.53.

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for the control of

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Where the normal dusting, smoking, or aerosoling with BHC or DDT after the beds are filled has not given adequate control of Mushroom Fly, growers have found the incorporation of LINDEX DUST (equivalent to 5% commercial BHC) in the compost on the last turn has been successful.

The normal rate of use of LINDEX DUST is 1 lb. per ton of compost, but rates as high as 10 lb. per ton have been used without deleterious effect on the mushroom.

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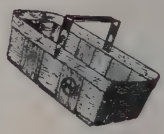

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WIDTH: 18 ft.

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HEIGHT: 6 ft. 6 ins. to 8 ft. at eaves.

BENCH OR TRAY: The houses are equally suitable for either system.

CAPACITY: An 18 ft. by 60 ft. house will hold over 500 (4 ft. by 2 ft.) trays.

Inside a typical KING Prefabricated Mushroom House, one of a number designed, manufactured and erected by Geo. W. King Ltd. for Dr. A. R. Rooke, Alton, Hants.

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Manure for mushroom culture such as that from racing stables is frequently in too long and dry a condition. This can be considerably improved by using ADCO "M" with better crops as a result.

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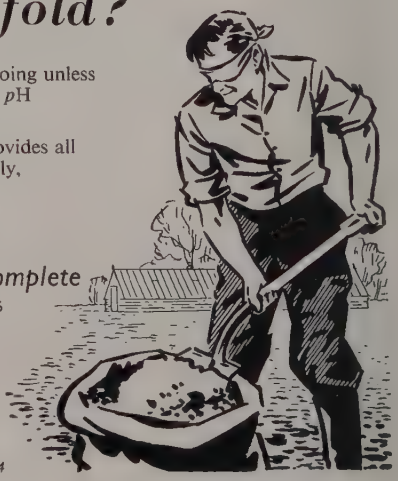

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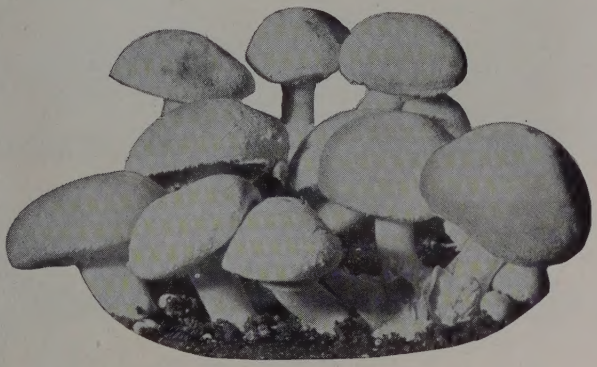

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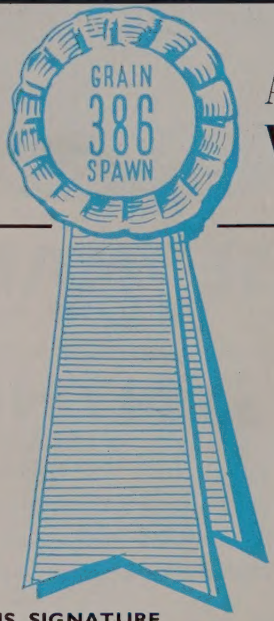

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